# Small White Lady's-Slipper (*Cypripedium candidum*) Monitoring Activities in Minnesota - 2013


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## Notice:

The small white lady's-slipper (*Cypripedium candidum*) is an orchid and thus vulnerable to collecting. As an orchid it is protected by Minnesota Statutes 18H.18. Collecting orchids requires the written permission of the landowner, and sale of wild-collected orchids requires a permit from the Commissioner of the Minnesota Department of Agriculture. The small white lady's-slipper is a Special Concern species under Minnesota's Endangered Species Law (M.S. 84.0895) and location data for this species is considered nonpublic data under M.S. 84.0872. Small white lady's-slipper location data contained in this document should not be publicized or shared with anyone outside your organization or agency, and should only be used for the protection and management of your agency's or organization's lands.

## Introduction

*Cypripedium candidum* Muhl. ex Willd. (small white lady's-slipper) occurs in the northeast and north central United States and in south-central and southeast Canada. It grows in mesic to wet-mesic prairies, wet prairie, tussock sedge meadow, and sometimes in calcareous fens (Minnesota DNR 2008). *Cypripedium candidum* is almost always found in high quality, relatively undisturbed habitats. It is sensitive to plowing, intensive grazing, herbicide spraying, repeatedly mowing for hay, and other disturbances (Smith, 2012). However, it may tolerate minimal or light disturbance of short duration.

The impetus driving the monitoring of this species is the recently completed Minnesota Prairie Conservation Plan (Minnesota Prairie Plan Working Group 2011) http://www.dnr.state.mn.us/prairieplan/index.html. This Plan is a collaborative effort among multiple partners with an interest or stake in conserving Minnesota's prairie landscape. The plan contains recommendations for protecting, enhancing, and restoring Minnesota's prairie heritage. It also requires monitoring as a means to measure the success of prairie conservation in the state and to evaluate impacts on animal and plant populations. *Cypripedium candidum* was chosen as one species that could be used to measure the success of the conservation plan. One criterion for success for native prairie plants is; "stable or increasing native prairie orchid populations, specifically the small white lady's slipper and the western prairie fringed orchid." The plan states that these two species were chosen because many populations of these species have already been documented, and they are correlated with high quality prairie, intact hydrology, and intact below-ground processes (fungal associates).

*Cypripedium candidum* is extant in 17 U.S. states and 2 Canadian provinces (NatureServe 2013). Minnesota has the largest number of populations of any state or province in the range of *C. candidum*. The number of populations recorded in Minnesota's Natural Heritage Information System (NHIS) is 385. However, the actual number of biological populations may be smaller. A number of mapped records are in close proximity to each other and could be combined, and some EOs reference extirpated or historic records. These 387 EOs are distributed across 52 counties in Minnesota. In contrast, Wisconsin has 70 EOs distributed across 12 counties; Iowa has 49 extant populations in 26 counties; and Manitoba has 19 extant populations (plus 2 that are likely extirpated). In addition, Michigan has extant populations in 19 counties; and North Dakota has extant populations in 10 counties (Wisconsin Natural Heritage Program pers. comm., Iowa Natural Heritage Program pers. comm., Manitoba Conservation Data Centre pers. comm., NatureServe 2013).

Population sizes vary greatly, but Minnesota has some of the largest populations in the range of this species and a higher number of large populations than other states and provinces. Wisconsin's largest population is currently a few hundred plants, although this population had been up to 10,000 plants previous to 2008 when it was set back by severe flooding. In Manitoba, 4 populations have more than 500 plants (with some likely more than 1000). In Iowa, 6 populations have 100-500 plants, 17 populations have 10-100 plants, and the remaining 26 have less than 10 plants (Wisconsin Natural Heritage Program pers. comm., Manitoba Conservation Data Centre pers. comm., Iowa Natural Heritage Program pers. comm.)

Comparing *C. candidum* counts from site to site, and from state to state or province is difficult. Past data reflect that some counts were of flowering culms (ramets). Other counts were of clumps that were believed by the observer to be an individual plant (genet). However, even when observers intend to count individual plants, there is no way to know exactly where one plant ends and another begins in situations where density of clumps and stems is very high. In the past, there has not been a standardized way of defining an individual for the purpose of monitoring this species.

### *Project Objectives*

1. Rarity Assessment

A status update of the species is important in order to assess the overall rarity of *C. candidum* in Minnesota. Currently records of *C. candidum* in Minnesota's rare features database need to be updated. About 25% of *C. candidum* populations have not been visited in 30 years, and at least half have not been visited in 20 years. One goal of the project is to determine the current number of populations. This would be done by confirming existing records and searching for new locations. Many of the old records are very imprecise and involved little search effort. Another goal of the project is to better document numbers of plants and detail the spatial extent of *C. candidum* in these populations. Standardized methods and new technology (GPS, GIS) will be used, that were not readily available when the old records were generated. As we confirm existing records, we will estimate numbers of *C. candidum* individuals and determine for each population the current spatial extent. In addition, condition of and threats to these populations will be documented.

2. Long-Term Trends in Selected Populations

Long-term data on *C. candidum* populations will help assess the effectiveness of management practices in high quality prairies and provide insight into long term changes in plant communities (e.g. due to climate change, agricultural drainage, etc.). Because of the difficulty in obtaining repeatable measurements of numbers of plants by counting or estimating them in large populations, we decided to subsample populations. Quantitative monitoring protocols are being developed to measure population trends. These protocols must be designed to detect biologically meaningful changes in population size and condition. The methods we develop will provide a quantitative basis for monitoring long-term change in populations. These methods will be applied to a selected number of sites.

## Methods

Monitoring sites were chosen from the set of all population records across the species' range in the state of Minnesota (Figure 1). That set was narrowed to include only sites in public or conservation ownership. Examples of conservation ownership are Wildlife Management Areas, Scientific and Natural

Areas, USFWS Waterfowl Production Areas, The Nature Conservancy preserves, and Native Prairie Bank easements on private land. Next, the set of sites was narrowed to include only sites containing moderate to large populations. This resulted in a pool of about 80 populations ranging in size from a few hundred plants to thousands of plants based on existing information. From that set, sites were selected for the 2013 field season. Sites in potentially marginal habitat (i.e. ditches) were excluded. Management factors such as grazing or hydrologic restoration of sites were also considered during site selection.

Baseline data were collected for each of 31 sites/populations that we visited. In 2013, numbers of clumps were estimated rather than censused (counted). A standardized data form provided number classes to place the population estimate in: 1-10; 10-100; 100-500; 500-1000; 1000-5000; 5000-10,000; 10,000+. For estimating numbers of plants at a site, the 'clump' was used. Clumps consist of clusters of stems. In some cases stems can be single in which case the clump consists of only one stem. For quantitative monitoring, a strict definition of a clump is applied, but for inventory work where lots of ground must be covered, clumps are based on a visual assessment of clusters of stems.

Handheld GPS units (Garmin GPSMap 76CSx, Garmin Montana 600, other units belonging to volunteers) were used to collect spatial data. These GPS units are typically accurate to 2-5 meters in open habitats. The collected data were projected in UTM zone 15, NAD 83, which is the MN DNR's standard GIS mapping projection. Waypoint data were then used to create detailed maps of lady's-slipper population boundaries at each site. Population distribution polygons were drawn by interpreting the GPS waypoints projected over aerial photography or other pertinent GIS map layers.

A standardized data form contained fields for observers to record observations of plant phenology; native plant community setting; site hydrology and topography; threats; and site management. Threats to populations may include invasive species, woody encroachment, and grazing/trampling in the area where the orchids are growing. A percent cover rating was estimated for each threat observed. It was also noted if any site management (burning, woody species removal, invasive species removal, mowing/haying, etc.) had occurred over the last year. If there was evidence of management activity on the site, the percentage of the *C. candidum* population affected by the activity was estimated and recorded.

Also in 2013, a quantitative monitoring method was tested at three sites for which detailed 2012 distribution mapping was available. An ArcGIS for Desktop tool called Create Random Points was used to place random points within the known distribution boundaries. To use the mapping tool, polygons within one site were "dissolved" into one feature. The input feature class file and the number of random points to create were entered into the tool. Then random points were generated within the designated polygon(s). These random points were used as sampling quadrat origins. A default azimuth for the site was chosen in a direction generally parallel to hydrological flow at the site as estimated by slope orientation.

In the field, the quadrat origin point was located. A meter tape was stretched out along the default azimuth. If the habitat encountered was unsuitable, the quadrat was run at the reverse azimuth (for example: to the south if the default azimuth was north). If habitat encountered in this reverse direction was also unsuitable, the random point would be rejected. If either direction were suitable, sampling at that random point was begun. Quadrats 25cm-wide of various lengths (10m, 20m, 25m) were sampled

along one side of the tape measure. The side of the tape measure sampled should be recorded in the field and must be consistent in subsequent sampling years. At Expandere WMA and Plover Prairie, quadrats were positioned on the east side of the transect line. At Highland Grove, quadrats were positioned on the north side of the transect line.

Stems and clumps were recorded for each five meter segment of quadrat. For clumps, the following definition was used: any stem or group of stems more than 15cm from any other stem or group of stems. A total of 55 quadrats were sampled at Highland Grove WMA, Plover Prairie Preserve, and Expandere WMA. Thirty-two quadrats were permanently marked. Only quadrats that contained evidence of *C. candidum* were permanently marked in 2013. Quadrats were marked by placing Berntsen DEEP1 Magnets for Utilities at each quadrat origin point. Metal spikes (galvanized nails and washers) were placed at the origin (0m) and ending point (10m or 20m, depending on quadrat length). If the quadrat end point was in standing water, the ending point spike was placed in a location short of the end of transect and this was noted on the data sheet. At some sites spikes were also placed at the mid-point (10m) of 20m long quadrats.

## Results

Thirty-one sites across the state were surveyed. Twenty-four of these sites were previously documented populations where 2013 surveys confirmed the presence of *C. candidum*. At four previously documented sites, populations could not be relocated in 2013. Three of the 31 sites were newly documented populations. These data were used to update the Natural Heritage Information System. More than 25,000 plants were estimated in total for all sites visited. Table 1 lists the sites, plant estimates, and additional notes for each site visited. One site, Sena WMA, was estimated to have 5000-10,000 plants. Seven other sites had populations estimated at 1000-5000. Three sites had population estimates of 500-1000; eight sites had populations of 100-500; and eight sites had less than 100 plants estimated. Maps with the observed distributions of *C. candidum* at each site are available in Appendix A. [This Appendix has been removed from some versions of this report as it contains sensitive species location information.]

Three new populations were documented in Mahnomen County. Plants were discovered in an area of Wambach WMA where they had not previously been documented. They were also documented on Rush WMA and Loncrace WMA. Examination of aerial photography of the land surrounding the newly discovered populations gives the appearance of additional, suitable habitat.

There were four sites where plants were not relocated: Halma Swamp WMA (Kittson County), Nelson Prairie WPA (Mahnomen County), New Folden WMA (Marshall County), and Lake Henry WPA (Stearns County). Halma Swamp WMA was surveyed for approximately one hour and no plants were relocated during this survey time. *Cypripedium parviflorum* var. *makasin* and *C. parviflorum* var. *pubescens* were observed at this site. Only a small portion of the Nelson Prairie WPA was surveyed in 2013 on the west side of U.S. Highway 59, without relocating *C. candidum*. The third site in which no plants were observed was the New Folden WMA. A local volunteer indicated that since the time of the original observation a number of township road expansion projects have occurred near the area that may have impacted the population. The fourth site in which no plants were observed was Lake Henry WPA. In

1997, one large clump with 25 stems was observed at this site. See the maps in Appendix A for the approximate search area of each of these sites.

*Quantitative Sampling Data*

Quadrats were sampled at three sites: Highland Grove WMA, Plover Prairie Preserve, and Expandere WMA. Within Highland Grove WMA, 27 random points were visited; three points were rejected immediately because of dense shrubs in quadrat or because the quadrat fell mostly in a ditch. Sampling was conducted at 24 points. At seven points, quadrats were sampled 25m west of point AND 25m east of point and no plants were observed in the quadrat. Eleven points had no plants in 10 meters sampled. Six points had plants in a 10m by 0.25m quadrat. The 6 quadrats with plants were permanently marked. Stem counts in 5m segments of quadrats ranged from 0 to 13 stems. Clumps counted were as high as 6 in one 5m segment, but most 5m segments contained 0, 1, or 2 clumps.

At Plover Prairie Preserve, 25 random points were visited. At five 10m quadrats, no plants were observed; at two 20m quadrats, no plants were observed. Three 10m quadrats contained plants; and fifteen 20m quadrats contained plants. The 18 quadrats with plants observed were permanently marked. Stem counts in 5m segments of quadrats ranged from 0 to 31 stems. Clump counts ranged from 0 to 9 for each 5m segment.

At Expandere WMA, 10 points were visited. At 2 points, quadrats had no plants observed. At 8 points, quadrats (all 20m long except for one 10m long quadrat) contained plants. The 8 quadrats with plants observed were permanently marked. Stem counts in 5m segments of quadrats ranged from 0 to 46 stems. Clump counts ranged from 0 to 7 per 5m segment.

We recruited volunteers to assist with baseline data collection, as well as with our quadrat sampling method. In 2013, 8 volunteers contributed a total of 74 hours to this project.

## Discussion

In 2013 less time was expended at any one site than was spent in 2012. Generally a half day or less was spent at each site, depending on site size and difficulty of access. More time was spent at Plover Prairie Preserve and Expandere WMA where sampling procedures were being tested. By estimating plant numbers rather than counting them, time was saved and more sites could be visited. Due to this adjustment of protocols and to additional staff, 31 sites were visited in 2013 in contrast to 18 sites in 2012. In 2012, 4 days were spent at Expandere WMA, trying to obtain an actual count of all of the plants. Based on 2013 work, estimating numbers is a more efficient way to survey sites. However, surveying and estimating numbers of plants at large sites is still a challenge. At 75% of the sites visited in 2013, only a portion of the potential habitat could be surveyed due to time limitations.

Two general methods were used to record GPS waypoints at sites. At some sites, points were taken throughout a population to represent the locations where *C. candidum* clumps were observed. It was not possible to record one GPS waypoint for each clump of lady's-slipper stems, so sometimes waypoints were recorded for groups of clumps. For example, one point might be recorded for one group of 5 clumps, or for one group of 10 clumps. For the other method, waypoints were recorded to delineate the population boundary. This method can be more efficient for covering a larger area, but a walk through the delineated polygon is also needed to confirm that plants are present throughout.

Future monitoring may benefit from standardizing the mapping procedures. Standardized mapping procedures among surveyors may make our methods more consistent and more repeatable.

As populations documented 20 or 30 years ago were revisited, our knowledge of the spatial extent of plants within these sites was improved. For example, in re-surveying Wambach WMA not only were more plants found than were originally documented (500-1000 in 2013 compared to 50-60 plants in the early 1990s), but they were found throughout a larger spatial area. In addition, we documented *C. candidum* at a new location within Wambach WMA and at two neighboring WMAs (Loncrace WMA and Rush WMA) where they had not previously been documented. A brief survey was conducted at each of these new locations. Examination of aerial photographs indicates that these new sites have more potential habitat that could be searched. Additional survey will likely reveal populations that are more expansive spatially and have higher numbers of plants than what was observed during brief surveys in 2013.

Quadrats sampled in 2013 were 0.25 meters wide and of variable length. Variable lengths were sampled in order to determine what length of transect would be optimal to consistently 'capture' plants, without being too tedious to survey. At Plover Prairie the 20 meter quadrats had plants in them more consistently than did the quadrats that were only 10 meters long. However, at Highland Grove, seven points where quadrats were run 25 meters in both directions did not have any plants observed in them. Perhaps our quadrat size was not sufficient to sample the plants at this site because of a sparse distribution, or perhaps the site had many dormant plants in 2013 that were not dormant in 2012. The 0.25 meter quadrat width was chosen after our initial pilot sampling at Ottawa WMA. It was found that examining a quadrat 25cm wide was much easier than examining a 50cm wide quadrat.

One of the many challenges that were encountered was the establishment of a counting unit within our quadrats. In 2013, both stems and clumps were counted within the quadrats. A clump was defined as any group of plants separated more than 15 cm from the next nearest clump and/or stems. Initially clumps were assumed to be genets (individual plants). However, excavation of a few plants revealed that what appeared as a single clump were actually two or more plants intertwined together below ground. In addition to this complex situation, occasionally plants were close enough together (within the 15cm) to create a single clump that was over 1 m in diameter. After these problems were identified, ramets (stems) were chosen as our counting unit for future quantitative monitoring. Photo page 1 illustrates root masses of excavated *C. candidum*.

We documented hybridization between species of *Cypripedium* in populations in northwest Minnesota. The challenge presented in these populations is in the enumeration of vegetative (non-flowering) plants. Hybridization was most evident at Wambach WMA in Mahnomen County in which hybrids were observed throughout the site. Photo Page 2 documents the hybridization with *C. candidum* on the left, the hybrid *C. X andrewsii* in the middle, and *Cypripedium parviflorum* var. *makasin* on the right. Smith (2012) discusses the extensive hybridization between these two species. When plants are vegetative, it is not possible to distinguish whether these are *C. candidum* ramets, some combination of *C. parviflorum* and *C. candidum* ramets, or hybrids of the two. All vegetative ramets will be counted in situations in which hybridization is present since the other species of *Cypripedium* likely reflect a similar dependency on high quality habitat, functioning hydrology, and underground mycorrhizal associations.

*Future Directions*

In 2014 and subsequent years, we intend to continue our work with two levels of monitoring. One level includes inventory of known and new sites, and mapping and estimating numbers of plants in a standardized way. We will visit as many sites as possible statewide to do this, including both protected and unprotected sites. This will be called Level 1 monitoring. The second level of monitoring (Level 2) includes quantitative long-term sampling. We hope to apply this level of monitoring at up to 30 sites statewide. Because of the dormancy observed in this plant, we intend to sample each of these sites annually. Sampling will occur at sites with some level of management and protection. 2014 will be another pilot year of sampling for our Level 2 work. We will test a different method from our 2013 quadrat method and then compare efficiency and effectiveness of the two methods.

## Acknowledgments

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## References

Minnesota Department of Natural Resources, Division of Ecological Resources. 2008. Rare Species Guide: An online encyclopedia of Minnesota's rare native plants and animals [Web Application]. Minnesota Department of Natural Resources, St. Paul, Minnesota. www.dnr.state.mn.us/rsg. Accessed December 30, 2013.

Minnesota Prairie Plan Working Group. 2011. Minnesota Prairie Conservation Plan 2010. Minnesota Prairie Plan Working Group, Minneapolis, MN. 55p.

NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: January 2, 2014 ).

Smith, Welby R. 2012. Native Orchids of Minnesota. University of Minnesota Press, Minneapolis, MN.

## Figures, Tables, Photos, and Appendices

Figure 1. *Cypripedium candidum* distribution (EOs), and 2012 and 2013 monitoring sites.

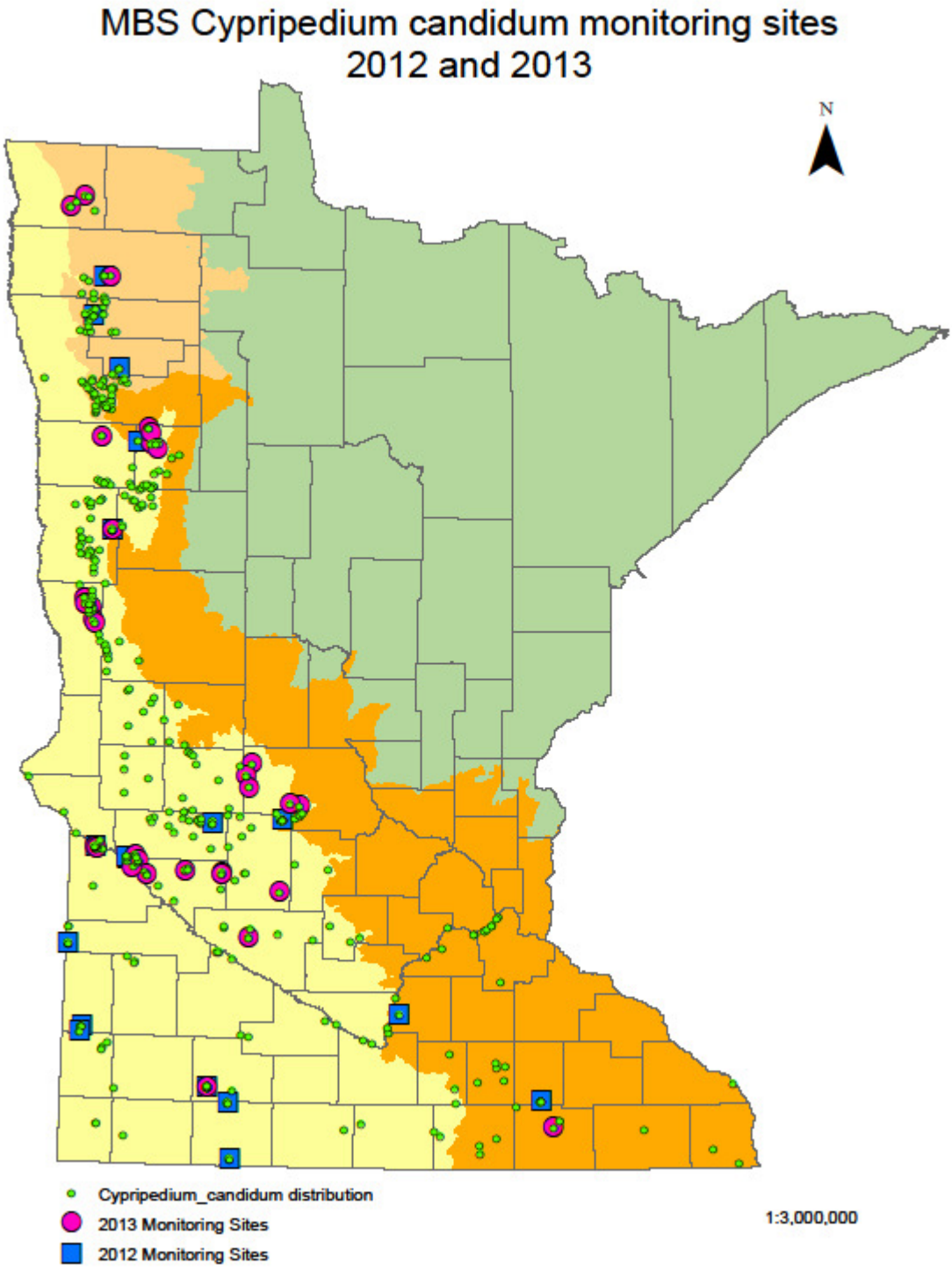

Table 1. Summary of 2013 monitoring results by site or Element Occurrence, including *Cypripedium candidum* plants estimated at each site.

| County | Site | Estimate | Est. Category | Comments |
|---|---|---|---|---|
| Chippewa | Appleton WPA | 119 | 100-500 | Potential unsearched habitat is 10 times the size of what we had time to search. |
| Chippewa | Cuka WMA | 508 | 500-1000 | Much potential habitat was not surveyed due to time limitations. |
| Chippewa | Grace Marshes WMA #284 & 292 | >1500 | 1000-5000 | West half has unnatural east to west-running narrow swales. Habitat D quality wet prairie. Not all potential habitat searched. |
| Chippewa | Grace Marshes WMA #285 | 407 | 100-500 | Not all potential habitat was searched. |
| Chippewa | Grace Marshes WMA #286 | 80 | 10-100 | Orchids are present in remnant prairie and at edges of wetlands adjacent to disturbed habitat. |
| Chippewa | Lac Qui Parle WMA – Hwy 40 | 200 | 100-500 | Population discovered by Wildlife managers after a burn in spring 2013. |
| Chippewa | Lac Qui Parle WMA – Milan WMA | 77 | 10-100 | More suitable habitat was not searched due to time limitation. Adjacent WPA to south appeared to be grazed. |
| Chippewa | Lac Qui Parle WMA – Watson Sag | 150 | 100-500 | We searched much of the available habitat near these points. Additional occurrence point across road to east was not surveyed. |
| Chippewa | Sena WMA | ~10,000 | 5000-10,000 | Based on area surveyed and estimated density in 10 x 10 meter plots. |
| Kandiyohi | Bomsta WPA | >1000 | 1000-5000 | Searched perhaps 1/3 of available habitat at this site. |
| Kittson | Halma Swamp WMA | 0 | 0 | Yellow lady's slippers present; did not get to all prairie habitat on site. |
| Kittson | Lake Bronson State Park | ~25 | 10-100 | Plants mostly vegetative; yellow lady's slippers present. |
| Lac Qui Parle | Plover Prairie | 1500 | 1000-5000 | Distribution mapped, additional clumps counted and 20 permanent transects established. |
| Mahnomen | Loncrace WMA | 50-100 | 10-100 | Newly discovered population; more suitable habitat on site needs to be surveyed. |
| Mahnomen | Nelson Prairie WPA | 0 | 0 | Only surveyed area west of Highway. No plants observed. |

Table 1. Continued.

| | | | | |
|---|---|---|---|---|
| Mahnomen | Rush WMA | 82 | 10-100 | Newly discovered population; more suitable habitat on site needs to be surveyed. |
| Mahnomen | Wambach WMA (#211 & #212) | 750 | 500-1000 | Yellow lady's slippers common; appears to be many hybrids; more suitable habitat on sites needs to be surveyed. Likely 5000-10,000 plants throughout larger area. |
| Marshall | New Folden WMA | 0 | 0 | No plants observed. |
| Mower | Wild Indigo SNA | 10 | 1-10 | Ca. 300 plants reported in 1981/1982. Not sure if exactly the same location(s) were searched. |
| Norman | Agassiz-Nelson WMA | 400-500 | 100-500 | Number estimates low; most plants vegetative and sparsely distributed over site. |
| Renville | Rocek-Becker WMA | 250-300 | 100-500 | Potential habitat at this site is quite limited. |
| Stearns | Behnen WPA | 36 | 10-100 | Prescribed burn in spring; Only 6 of 75 stems in flower. |
| Stearns | Lake Henry WPA | 0 | 0 | Small population observed 1997; not relocated in 2013. |
| Stearns | Prairie Storm WPA | 1000+ | 1000-5000 | A portion of this population is on private land. |
| Stearns | Sedan Brook SNA | 100s | 100-500 | Mesic to wet prairie. |
| Stearns | Zion WPA | 4 | 1-10 | Small mesic prairie remnant. |
| Wilkin | Anna Gronseth Prairie TNC (#120) | | 500-1000 | 2-3 times the number of plants of earlier observation; did not visit small sub-populations on far side of site. |
| Wilkin | Atherton WMA | | 100-500 | Only surveyed area in vicinity of former old EO; Additional suitable habitat at site not surveyed. |
| Wilkin | Rothsay WMA (#153, #159, & #160) | | 1000-5000 | Large site; difficult to access some portions; likely 10,000+ plants on site. Additional EOs and suitable habitat available to survey at site. |
| Wilkin | Town Hall Prairie (#121 & #156) | >1200 | 1000-5000 | Appears to be more habitat at site, but effort focused in areas of past observation. |
| Wilkin | Western Prairie SNA | | 1000-5000 | |

Photo Page 1. Excavated roots of *Cypripedium candidum*. This work was a collaboration between Minnesota Biological Survey Plant Ecologist Nancy Sather and Dr. Jyotsna Sharma of Texas Tech University.



In this case the two ramets were joined (see rhizome branching in photo above right), but in other cases, multiple plants were growing together with intertwined roots.


This is a young plant, probably 4-5 years old.

Photo Page 2. Hybridization in *Cypripedium* species, evident at sites in northwest Minnesota. These stems are examples of plants seen at Wambach WMA. (Photo by Derek Anderson, June 26, 2013).

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